Reducing Sediment Loading Impacts Through Improved Stream Crossing Design on Forest Roads

Kris Brown and Rien Visser

School of Forestry, University of Canterbury

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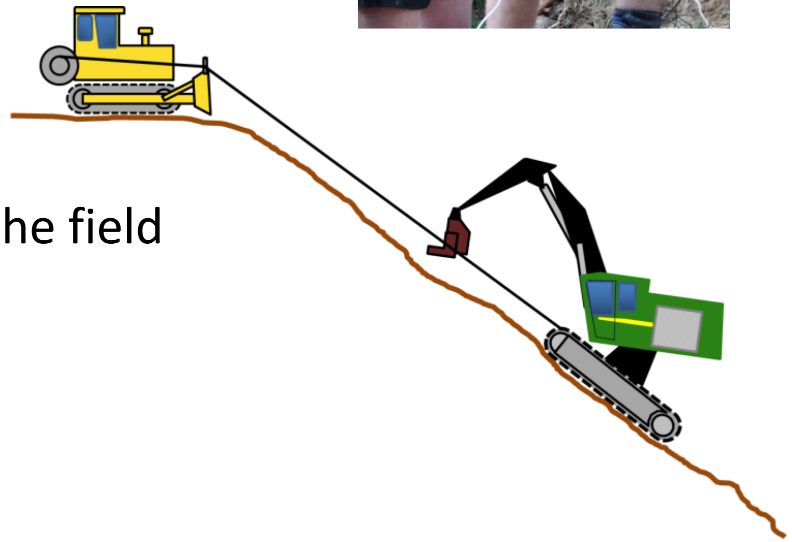
Forest Engineering - Research at UC

Rien Visser, Hunter Harrill, Kris Brown
(+ other faculty at SOF depending on projects)

Examples of activity:

Future Forest Research (FFR)

- Harvesting cost and productivity benchmarking
- Tension monitoring of cable yarders and cable-assisted machines
- Design & evaluation of Apps to measure tension & deflection in the field
- Evaluation of modern European steep terrain equipment
- Workshops on cable rigging configurations



Forest Engineering - Research at UC

Current Post-graduate research (PhD and Masters)

- Alejandro Farias – Geospatial technologies in forest harvesters as a tool for site specific management
- Paul Oyier – Fuel consumption of harvest machines and common systems
- Thornton Campbell – Viability of the Austrian-built Koller 602H cable yarder in NZ
- Goetz Roth – Managing data and wood flow from mechanized harvesters

Undergraduate Student Dissertation Projects (about 6 per year)

- Sediment trap design
- Machine fires associated with forest harvesting
- Review of work hours and fatigue
- Use of timber for construction projects in China
- Accuracy of harvester head

Reducing Sediment Loading Impacts Through Improved Stream Crossing Design on Forest Roads

- Approximately 1600 km of new roads will be constructed annually for the next 5-10 years
- “New” forestland to be harvested is characterized by steep slopes, erodible soils, and remote locations

Potential for sediment delivery

Highest at stream crossings, especially during the construction and use phases

Poor road location or BMP implementation may lead to chronic sedimentation after harvesting

Example: Problem road segments

Brown et al., 2013

- Surface runoff traveled 75 and 130 m between the nearest water control structure and the silt fence
- 90 to 100% bare soil conditions throughout the year

Forestry Best Management Practices (BMPs)

- Designed to protect water quality
- BMPs for road location, gradient, water control, surface cover, and sediment trapping
- Guidance outlined in NZFOA Forest Road Engineering Manual (2012), Environmental Code of Practice (2007)

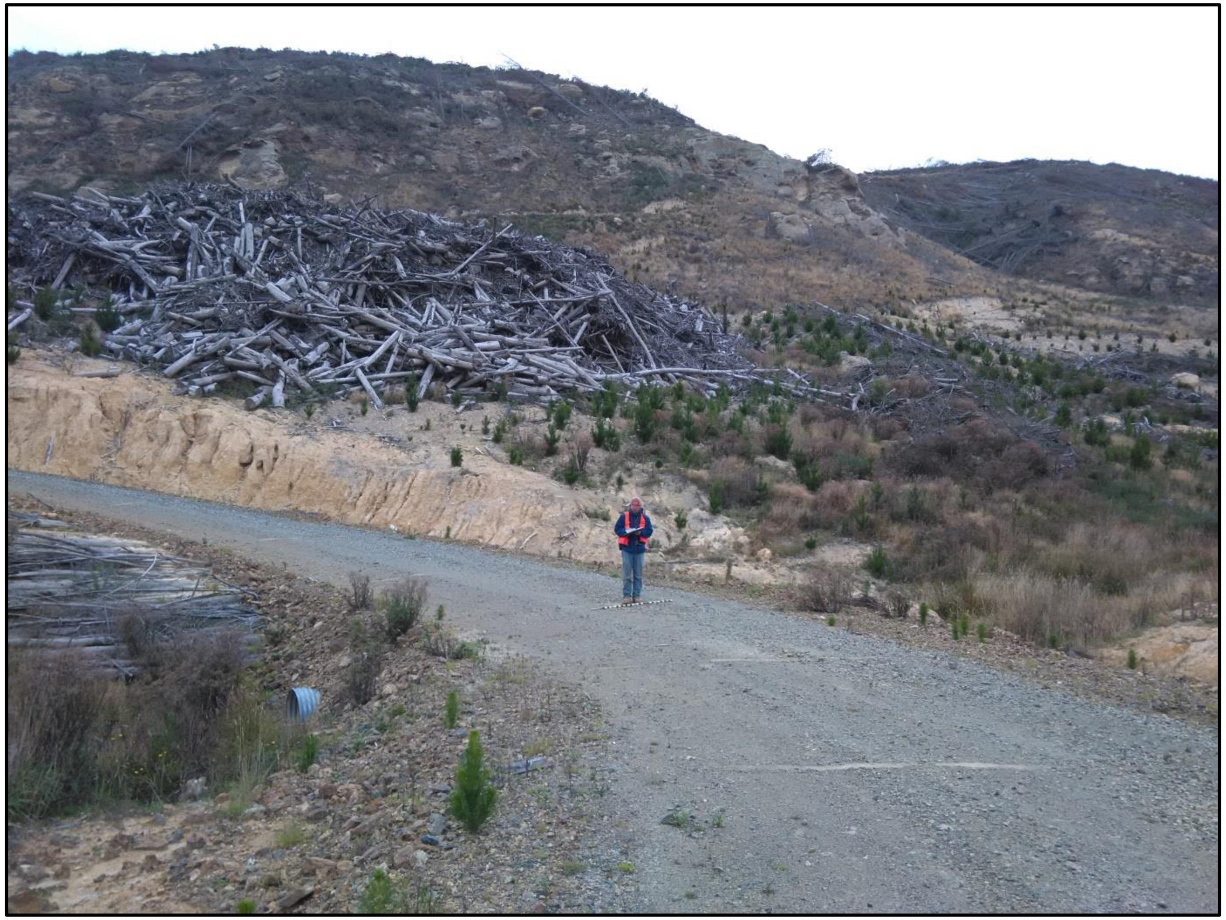
Increased stringency of water quality rules in NZ

- 2014 National Policy Statement on Freshwater Management
  - Requires improved knowledge of sediment loading rates from major sources
  - Councils required to maintain or improve water quality
- 2015 Proposed National Environmental Standards for Plantation Forestry
- **The cost-effectiveness of existing BMPs to reduce sediment is not well known**

Current Research: Characterise forest road-stream crossings and evaluate BMP implementations

1. Characterize road design (approach slope, camber, ditches, cut and fill batters)
2. Surface cover and water control practices on the stream-crossing approach
3. Evaluation of the stream crossing structure itself

Crossing surveys



Focus on: **Water control BMPs**

Objectives: control runoff volume and velocity; redirect runoff away from the stream and onto stable areas

Cross-drain spacing based on road gradient and soil erodibility

Fluming to avoid surface runoff over unconsolidated fill slopes

Other examples:
Broad based dips
Cut-outs
Road camber

Focus on: **Surface cover BMPs**

Objective: stabilize bare soil

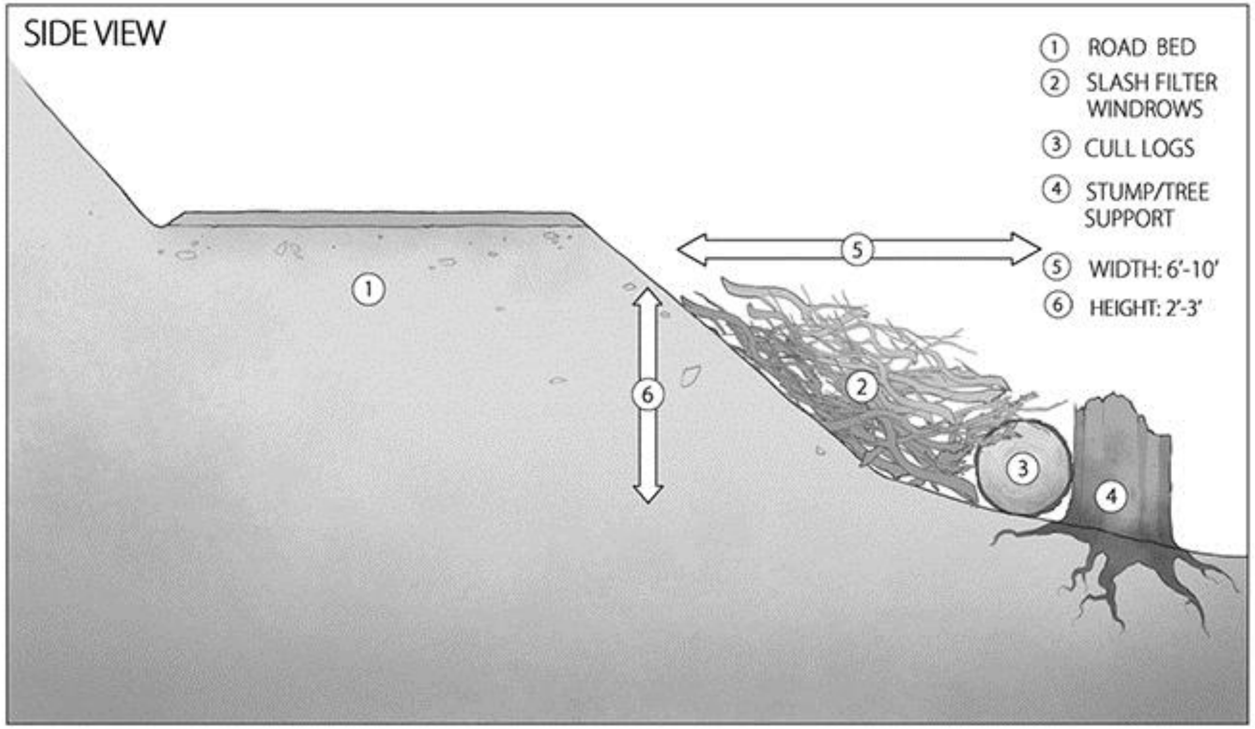
Graveled stream crossing approach

Stable table drain

Stable, vegetated cut and fill slopes

Focus on: **Sediment trapping**

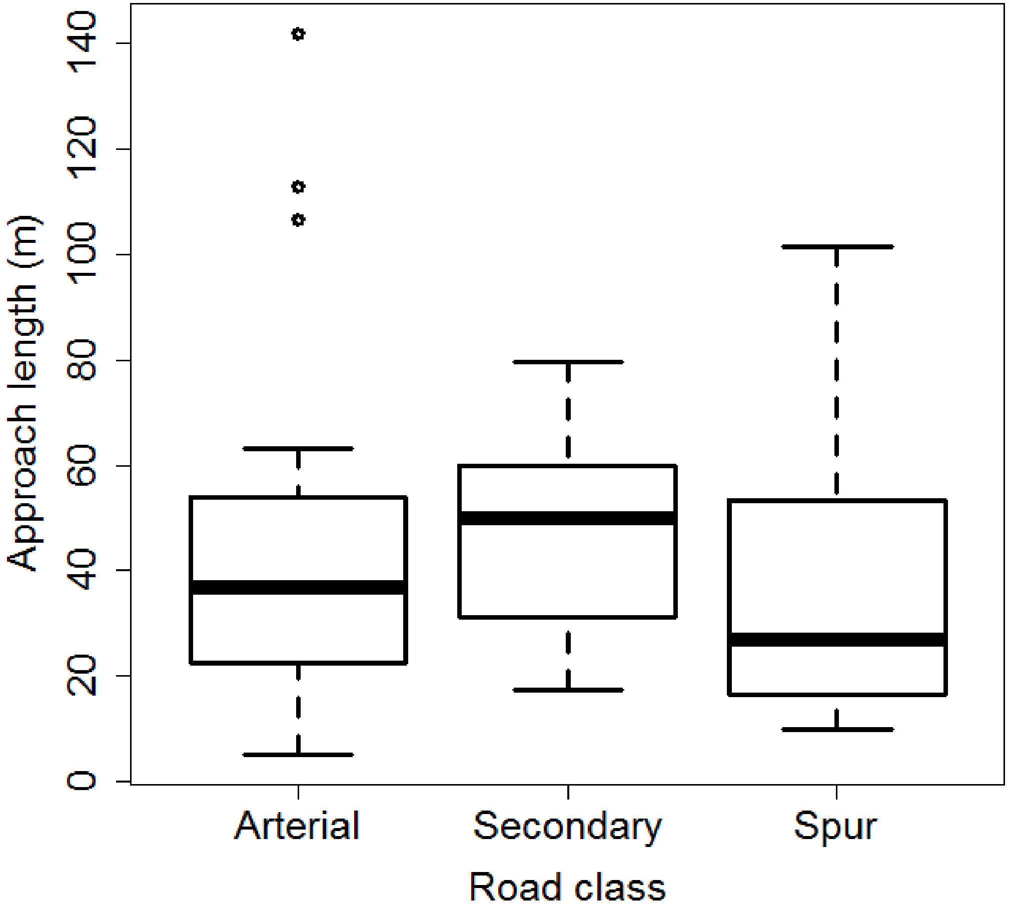
Slash filter windrow



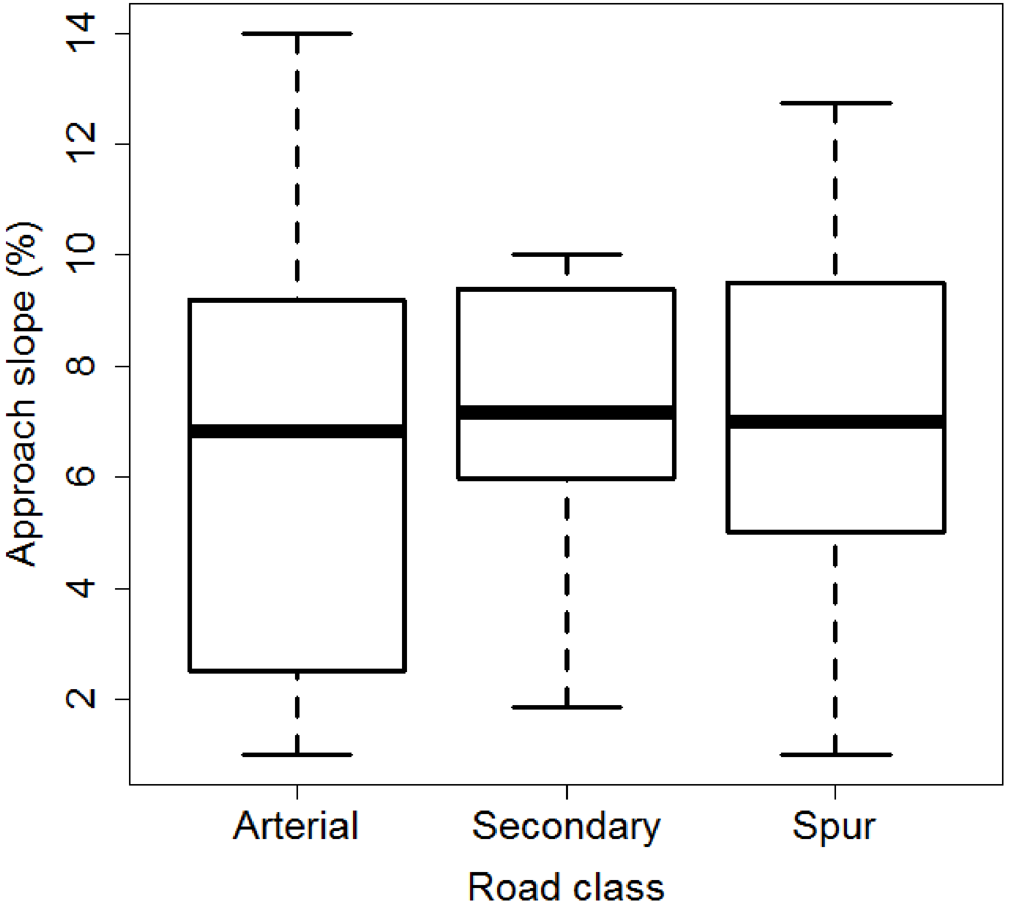
From Idaho Forestry BMPs
http://www.uidaho.edu/extension/idahoforestrybmps/how-to/build-slash-filter-window

Water control

Approach length

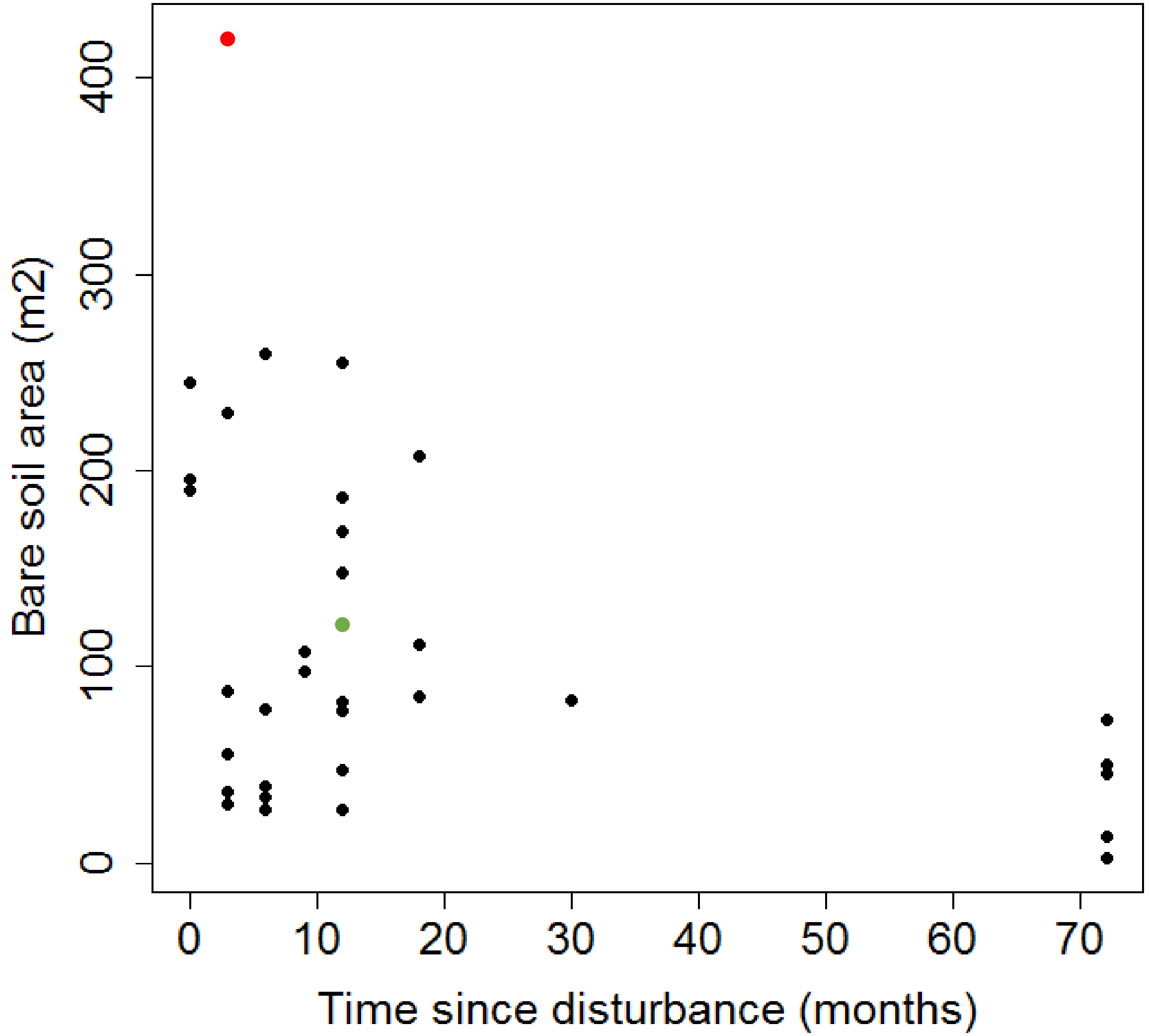


Approach slope



Bare soil area

Bare soil area (m^2) per crossing



BSA = 421 m^2

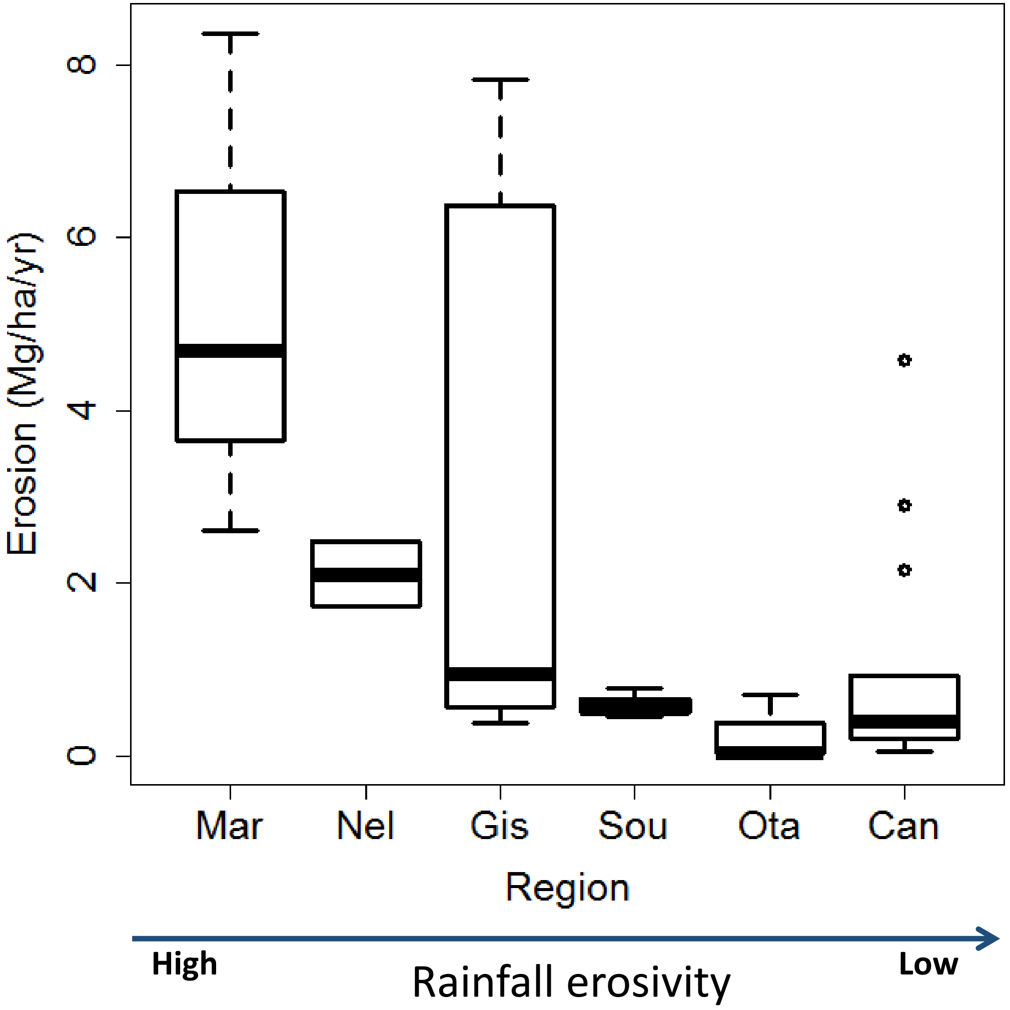
BSA = 121 m^2

Relative contribution to total bare soil area at each crossing:

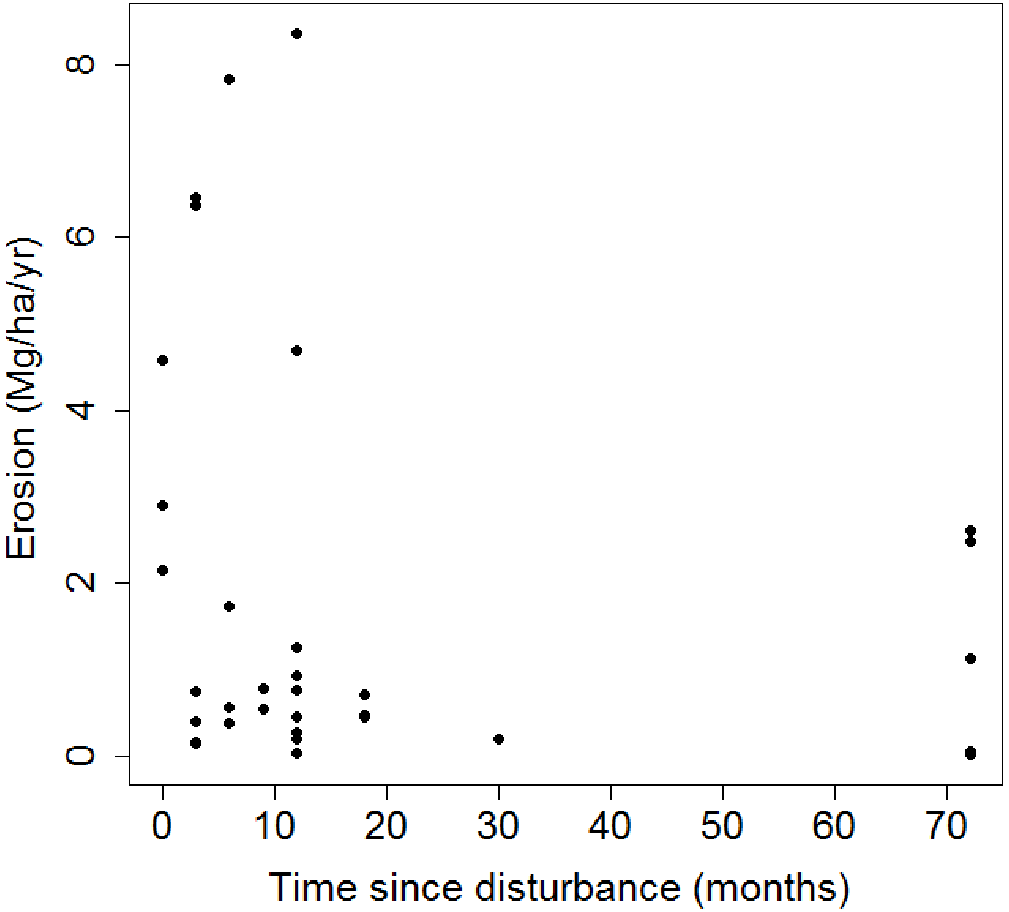
Formation>Cut>Fill>Ditch

Erosion rates on the approaches

By region



By time since disturbance



Preliminary findings

- 39 crossings surveyed to date

- Potential erosion on the stream crossing approaches was generally low (range = 0.01 to 8.4 Mg ha^{-1} yr^{-1})

- Sediment delivery potential was highest for recently constructed road-stream crossings and decreased with time

Future research

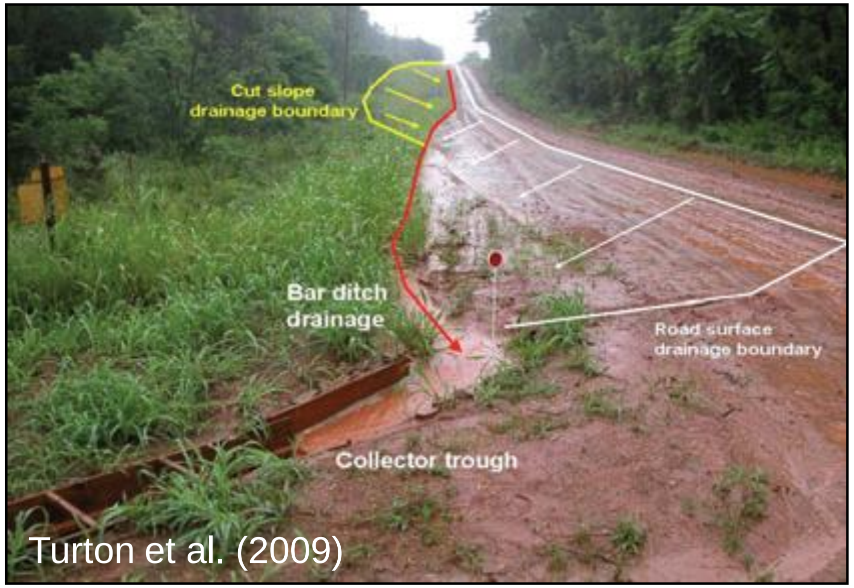
- **Field studies to quantify BMP cost-effectiveness** to reduce surface erosion and sediment delivery from major sources (i.e., road formation, cut and fill slopes, and table drains)

- **Where?:** At road-stream crossings

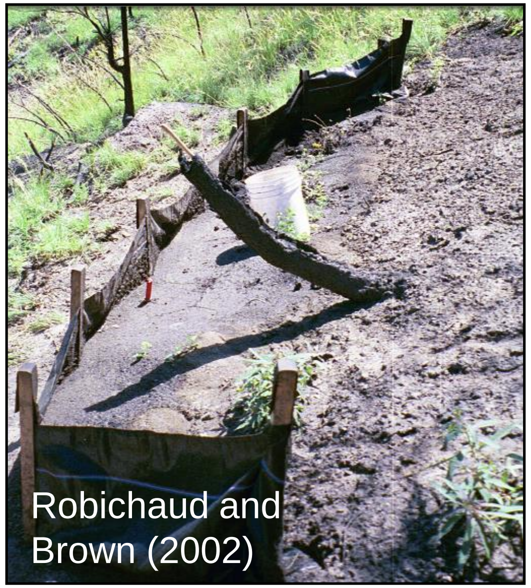
- **When?:** During road construction and use phases

Thank you

Field studies to quantify BMP effectiveness



Turton et al. (2009)


Robichaud and Brown (2002)

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